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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/765,516	01/18/2001	Keith M. Chugg	06666/060001/USC-2990	9524

20985 7590 06/21/2004

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EXAMINER	
PERILLA, JASON M	

ART UNIT	PAPER NUMBER
2634	

DATE MAILED: 06/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/765,516	Applicant(s) CHUGG ET AL.	
	Examiner Jason M Perilla	Art Unit 2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 18 January 2001.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-17 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-7 and 9-17 is/are rejected.

7)☒ Claim(s) 8 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 18 January 2001 is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-17 are pending in the instant application.

Drawings

2. Figures 1A-1D, 2A-2D, and 3A-3D should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

3. Figures 1C, 1D, 2C, 2D, 5, 10, and 16 are objected to because they are not referenced to or described by the specification.

4. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the Kalman filter of claim 11, the phase-locked loop of claim 14, and the open-loop estimator of claim 15 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

5. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

Regarding claims 3-10, antecedent basis should be provided in the specification for the min/sum, sum/product, max/product, and min*/sum operator limitations.

Regarding claim 11, antecedent basis should be provided in the specification for a Kalman filter channel estimator for each trellis state in each of the forward and backward operators.

Regarding claim 12, antecedent basis should be provided in the specification for a least mean-square estimator for each trellis state in each of the forward and backward operators.

Regarding claim 13, antecedent basis should be provided in the specification for a non-linear estimator for each trellis state in each of the forward and backward operators.

Regarding claim 15, antecedent basis should be provided in the specification for an open-loop estimator for each trellis state of the forward and backward operators.

Claim Objections

6. Claim 8 is objected to because it is substantially identical to claim 3.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

8. Claim 14 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it

pertains, or with which it is most nearly connected, to make and/or use the invention. The use of a phase locked loop as a non-linear estimator for each trellis state is not enabled by the specification so that one skilled in the art would be able to make or use the invention. The Examiner asserts that the use of a phase locked loop as a non-linear estimator of a trellis state is not a well known or accepted procedure in the art, and therefore, the claimed usage of it is not enabled by the specification. If the Applicant contests that the use of a phase locked loop as a non-linear estimator of a trellis state is well known in the art, evidence should be provided to be considered by the examiner.

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 3-7, and 9-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 3, limiting the operator to be a "min/sum" operator makes the claim indefinite. The specification does not provide for a clear definition of a "min/sum" operator, and one skilled in the art is unable to determine conclusively the meaning and scope of the limitation. It is uncertain how using a minimum and/or a sum are used to limit the operator. Further, the use of "/" in "min/sum" is further indefinite because it may be interpreted to be an operator itself such as a division operator or it may be interpreted to be some type of comparison.

Regarding claims 4-6, the claims are indefinite because they are based upon indefinite parent claims.

Regarding claim 7, limiting the operator to be a "sum/product" operator makes the claim indefinite. The specification does not provide for a clear definition of a "sum/product" operator, and one skilled in the art is unable to determine conclusively the meaning and scope of the limitation. It is uncertain how using a sum and/or a product are used to limit the operator. Further, the use of "/" in "sum/product" is further indefinite because it may be interpreted to be an operator itself such as a division operator or it may be interpreted to be some type of comparison.

Regarding claim 9, limiting the operator to be a "max/product" operator makes the claim indefinite. The specification does not provide for a clear definition of a "max/product" operator, and one skilled in the art is unable to determine conclusively the meaning and scope of the limitation. It is uncertain how using a sum and/or a product are used to limit the operator. Further, the use of "/" in "max/product" is further indefinite because it may be interpreted to be an operator itself such as a division operator or it may be interpreted to be some type of comparison.

Regarding claim 10, limiting the operator to be a "min*/sum" operator makes the claim indefinite. The specification does not provide for a clear definition of a "min*/sum" operator, and one skilled in the art is unable to determine conclusively the meaning and scope of the limitation. It is uncertain how using a sum and/or a product are used to limit the operator. Further, the use of "*/" in "min*/sum" is further indefinite because it may be interpreted to be an operator itself or it may be interpreted to be some type of comparison. It is noted by the Examiner that if "*/" is a typographical error, then the claim may reduce to be substantially identical to claim 3.

Claim Rejections - 35 USC § 102

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claim 17 is rejected under 35 U.S.C. 102(b) as being anticipated by Sandell et al ("Iterative Channel Estimation using Soft Decision Feedback", Global Telecommunications Conference, Nov. 1998; hereafter "Sandell").

Regarding claim 17, Sandell discloses an iterative receiver system (abstract), comprising: a channel processor or channel estimator (fig. 1, "CHANNEL ESTIMATOR") configured to receive a plurality of coded symbols (fig. 1, ref. L(bk); sec. 2.2), said channel processor operating to produce and update soft information on said plurality of coded symbols (sec. 2), where said channel processor is activated by updated soft information on interleaved code symbols (inherent); a soft-in/soft-out decoder configured to receive said soft-information on said plurality of coded symbols (fig. 1, "DECODER") , said soft-in/soft-out decoder operating to compute soft information on said coded symbols (sec. 2.2); and, an interleaver/de-interleaver pair or data bus operating to pass said soft information to/from said channel processor from/to said soft-in/soft-out decoder, where after several iterations, final bit decisions are made on uncoded bits by said soft-in/soft-out decoder by thresholding the corresponding soft information produced by said soft-in/soft-out decoder (sec. 2 – "Channel Estimation"; para. 1). It is inherent that the channel processor is activated by updated soft information because the updated soft information is the input to the channel processor which it is intended to act upon. Further, the connections between the channel processor or channel estimator and the soft-in/soft-out decoder represent the

interleaver/de-interleaver because they are used to transmit the soft information between the channel processor and the decoder.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. Claims 1-6, 15, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Viterbi et al (US 5933462; hereafter "Viterbi") in view of Parr et al (US 5537419; hereafter "Parr").

Regarding claim 1, Viterbi discloses a system for estimating inputs and outputs of a digital transmission system, comprising: a receiver front-end (inherent) configured to receive an observed digital signal in the digital transmission system; a forward recursion element (fig. 4, ref. 24) adapted to receive the observed digital signal, and generate a first sequence of soft information by performing a forward recursion (col. 4, lines 21-34); a backward recursion element (fig. 4, ref. 26) adapted to receive the observed digital signal, and generate a second sequence of soft information by performing a backward recursion (col. 4, lines 35-44), and a combiner (fig. 4, ref. 28) configured to compute a transitional information that ties forward and backward estimates of said first and second sequences of soft information together (col. 4, lines 45-64), said combiner operating to generate soft information on the inputs and outputs of the transmission system by combining updated first and second sequences of soft information and said

transitional information (col. 4, lines 45-54). Viterbi does not disclose the at least one forward channel estimator adapted to receive the observed digital signal and said first sequence of soft information, said at least one forward channel estimator operating to estimate channel parameters using said first sequence of soft information or the at least one backward channel estimator adapted to receive the observed digital signal and said second sequence of soft information, said at least one backward channel estimator operating to estimate channel parameters using said second sequence of soft information. However, the use of channel estimators to estimate the channel impulse response and characteristics of a channel using soft information from decoders or equalizers is well known in the art as taught and exemplified by Parr. Parr teaches a system wherein a channel response estimator (fig. 2, ref. 32) is adapted to receive the observed digital signal z(n) and said first sequence of soft information a(n) (col. 5, lines 35-43), the channel estimator operating to estimate channel parameters using said first sequence of soft information (col. 1, lines 32-49; col. 2, lines 31-51; col. 5, lines 5-45). While the forward and backward decoders of Viterbi (fig. 4, refs. 24 and 26) are maximum likelihood sequence estimation decoders, the equalizer (fig. 2, ref. 21) of Parr is a maximum likelihood sequence estimation based equalizer, and it is very closely related to the decoder of Viterbi. One skilled in the art is familiar with channel estimation using the soft information from decoders or equalizers as taught by Parr. The use of the soft information to create a channel estimation is advantageous because the channel impulse response does not need to be generated beforehand (col. 1, lines 40-50). Therefore, it would have been obvious to one having ordinary skill in the art at

the time which the invention was made to utilize the channel estimation technique of Parr using soft information in the system of Viterbi because the channel response information generated in this manner is generated adaptively and does not need to be gathered before decoding begins and it is advantageously used by the maximum likelihood sequence estimators to decode the received signal. Further, it would have been obvious to use a forward channel estimator and a backward channel estimator in the system of Viterbi because both forward and backward recursion elements are disclosed by Viterbi. Each of the forward and backward recursion elements would both benefit from individual channel estimates derived form the soft information produced by the forward and backward recursion elements.

Regarding claim 2, the limitations of claim 1 are disclosed by Viterbi in view of Parr as applied above. Further, Viterbi discloses that said forward recursion element is a Trellis-based forward operator, and said backward recursion element is a Trellis-based backward operator, where each operator generates a sequence of Trellis state soft information updates (figs. 2 and 5; col. 6, lines 14-65).

Regarding claim 3, the limitations of claim 2 are disclosed by Viterbi in view of Parr as applied above. Further, Viterbi discloses that each of said Trellis-based forward operator and backward operator is a min/sum operator (col. 2, lines 34-47). The forward and backward operators involve add/compare/select operations to decode the received signals. It is disclosed by Viterbi that the maximum likelihood sequence is found by the path with the best metric for decoding. Therefore, the forward and

backward operators of Viterbi are min/sum operators because the add/compare/select operations are equivalent to the min/sum operations.

Regarding claim 4, the limitations of claim 3 are disclosed by Viterbi in view of Parr as applied above. Further, Viterbi discloses that each of said min/sum operators performs min/sum operations on said sequence of Trellis state soft information updates (col. 2, lines 34-47).

Regarding claim 5, the limitations of claim 4 are disclosed by Viterbi in view of Parr as applied above. Further, Viterbi discloses that each of said min/sum operators computes soft output for the inputs and outputs defined by Trellis state transitions (col. 2, lines 34-47).

Regarding claim 6, the limitations of claim 5 are disclosed by Viterbi in view of Parr as applied above. Further, Viterbi discloses that the said soft output for the inputs and outputs defined by Trellis state transition is computed as min/sum of a starting state forward soft information, said Trellis state transition, an ending state backward soft information, and a binding factor (figs. 2 and 3; col. 6, lines 14-65; col. 7, lines 45-65).

Regarding claim 15, Viterbi in view of Parr disclose the limitations of claim 2 as applied above. Further, the add/compare/select method (col. 2, lines 34-47) disclosed by Viterbi represents an open-loop estimator for each trellis state.

Regarding claim 16, Viterbi discloses a method for estimating inputs and outputs of a digital transmission system, comprising: receiving an observed digital signal in the digital transmission system; generating a first sequence of soft information by performing a forward recursion (fig. 4, ref. 24; col. 4, lines 21-34); generating a second

sequence of soft information by performing a backward recursion (fig. 4, ref. 28; col. 4, lines 35-44); computing a transitional information that ties forward and backward estimates of said first and second sequences of soft information together (fig. 4, ref. 28); and generating soft information on the inputs and outputs of the transmission system by combining updated first and second sequences of soft information and said transitional information (col. 4, lines 45-64). Viterbi does not disclose estimating channel parameters using said first sequence of soft information and said observed digital signal and estimating channel parameters using said second sequence of soft information and said observed digital signal. However, the use of channel estimators to estimate the channel impulse response and characteristics of a channel using soft information from decoders or equalizers is well known in the art as taught and exemplified by Parr. Parr teaches a system wherein a channel response estimator (fig. 2, ref. 32) is adapted to receive the observed digital signal z(n) and said first sequence of soft information a(n) (col. 5, lines 35-43), the channel estimator operating to estimate channel parameters using said first sequence of soft information (col. 1, lines 32-49; col. 2, lines 31-51; col. 5, lines 5-45). While the forward and backward decoders of Viterbi (fig. 4, refs. 24 and 26) are maximum likelihood sequence estimation decoders, the equalizer (fig. 2, ref. 21) of Parr is a maximum likelihood sequence estimation based equalizer, and it is very closely related to the decoder of Viterbi. One skilled in the art is familiar with channel estimation using the soft information from decoders or equalizers as taught by Parr. The use of the soft information to create a channel estimation is advantageous because the channel impulse response does not need to be generated beforehand (col. 1, lines

40-50). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the channel estimation technique of Parr using soft information in the system of Viterbi because the channel response information generated in this manner is generated adaptively and does not need to be gathered before decoding begins and it is advantageously used by the maximum likelihood sequence estimators to decode the received signal. Further, it would have been obvious to use a forward channel estimator and a backward channel estimator in the system of Viterbi because both forward and backward recursion elements are disclosed by Viterbi. Each of the forward and backward recursion elements would both benefit from individual channel estimates derived form the soft information produced by the forward and backward recursion elements.

14. Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Viterbi in view of Parr, and in further view of Baccarelli et al ("Combined Channel Estimation and Data Detection Using Soft Statistics for Frequency-Selective Fast-Fading Digital Links", IEEE Transactions on Communications, April 1998; hereafter "Baccarelli").

Regarding claim 11, Viterbi in view of Parr disclose the limitations of claim 2 as applied above. Viterbi in view of Parr do not disclose that each of said forward and backward operators includes a Kalman filter channel estimator for each Trellis state. However, Baccarelli teaches a trellis decoder using the well known Kalman filter type channel estimator (pg. 424, col. 1, lines 19-25). Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to use a Kalman filter channel estimator as taught by Baccarelli in the system of Viterbi in view of

Parr because it is a well known advantageous technique used in the art for decoding and channel estimation.

15. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Viterbi in view of Parr, and in further view of Suarez et al (US 6128346; hereafter "Suarez").

Regarding claim 12, Viterbi in view of Parr disclose the limitations of claim 2 as applied above. Viterbi in view of Parr do not disclose that each of said forward and backward operators includes a least mean-square estimator for each Trellis state. However, Suarez teaches a decoding method using a least mean-square estimator for each Trellis state (col. 4, lines 7-14). One skilled in the art is familiar with the various techniques of decoding a received signal using a trellis, and Suarez teaches the use of an exemplary method which would be applicable to the system of Viterbi in view of Parr. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the least mean-square estimator as taught by Suarez in the system of Viterbi in view of Parr because it is a well known advantageous technique used in the art for decoding with a trellis.

Regarding claim 13, Viterbi in view of Parr disclose the limitations of claim 2 as applied above. Viterbi in view of Parr do not disclose that each of said forward and backward operators includes a non-linear estimator for each Trellis state. However, Suarez teaches a decoding method using a least mean-square estimator for each Trellis state (col. 4, lines 7-14). One skilled in the art is familiar with the various techniques of decoding a received signal using a trellis, and Suarez teaches the use of

an exemplary method which would be applicable to the system of Viterbi in view of Parr. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to utilize the least mean-square estimator as taught by Suarez in the system of Viterbi in view of Parr because it is a well known advantageous technique used in the art for decoding with a trellis. Further, a least mean square estimator is a non-linear operator.

Conclusion

16. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following prior art of record not relied upon above is cited to further show the state of the art with respect to iterative SISO decoder and channel estimator pairs.

- U.S. Pat. No. 6014411 to Wang.
- U.S. Pat. No. 5818876 to Love.
- U.S. Pat. No. 5721746 to Hladik et al.
- U.S. Pat. No. 5721745 to Hladik et al.
- U.S. Pat. No. 6002716 to Meyer et al.
- U.S. Pat. No. 5596607 to Larsson et al.
- U.S. Pat. No. 5680419 to Bottomley.
- U.S. Pat. No. 5889823 to Agazzi et al.
- U.S. Pat. No. 5442627 to Viterbi et al.
- U.S. Pat. No. 6108386 to Chen et al.
- U.S. Pat. No. 5297169 to Backstrom et al.

- Kallel et al, "Bidirectional Sequential Decoding", IEEE Transactions on Information Theory, Volume: 43, Issue: 4, July 1997, Pages:1319 – 1326.
- Chang et al, "Iterative joint sequence and channel estimation for fast time-varying intersymbol interference channels", IEEE International Conference on Gateway to Globalization, Volume: 1, June 1995, Pages:357 – 361.

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M Perilla whose telephone number is (703) 305-0374. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Steven Chin can be reached on (703) 305-4714. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jason M. Perilla
June 9, 2004

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